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A review on feed-in tariff in Australia, what it is now and what it should be

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ABSTRACT

The objective of this paper is to review the feed-in tariffs introduced and now are being implemented in different states and territories of Australia for the grid-connected small-scale solar photovoltaic (PV) systems. A further objective is to take a closer look at the production cost of these solar PV systems to compare with the introduced feed-in tariffs. The review results show that the gap between production cost of PV electricity and the feed-in tariff is relatively high, particularly in those states, were feed-in tariff based on net metering is implemented.

Contents

1. Introduction

Feed-in tariff (FIT) is one of the most effective ways to encourage residential sector and small businesses to install solar PV technology by paying a premium price for the electricity their PV system generates. This is a good way for consumers to produce part of the electricity they need by on-site PV generators. Although solar radiation is intermittent because of daily and seasonal variations, but the correlation between solar radiation and daytime peak electricity demand makes these solar PV system helping to provide electricity during peak demand times. For each kWh of electricity that these solar PV systems generate, the owner will be paid at a rate normally greater than the retail price that the owner would usually pay to the electricity company, to buy the same amount of electric energy. Different feed-in tariff rates are used by different countries around the world, but the one introduced by Germany has been one of the most successful programs.

2. Feed-in tariff mechanism

The output terminals of the PV system are connected to the household loads and also connected to the grid via a bi-directional meter [1]. There are two different types of meter recordings:

- Gross metering.
- Net metering.

In gross metering, meter records the total kWh of electricity produced by the PV system. The gross payment system will deliver higher paybacks to the PV owners.

In net metering, the meter recording is based on the difference between the total kWh of energy produced by PV system and that portion of this production that is used by the household loads.

When the output power of PV system is more than what is required by the household loads, the excess electricity is fed into

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Table 1
FIT currently implemented in different Australian states and territories.

	State	Max. size of PV	Rate	Gross production net export
1	Victoria	5 kW	Up to 66 cents	Net
2	Western Australia	TBA	60 cents (July 2010)	Net
3	South Australia	10 kW	44 cents	Net
4	Northern Territory	TBA	TBA	Net
5	Queensland	10 kW	44 cents	Net
6	Australia Capital Territory	10 kW	50.05 cents	Gross
7	New South Wales	10 kW	60 cents	Gross
8	Tasmania	3 kW	20 cents	Rate equal to the normal electricity price

the electricity network via the export register of the meter. The meter records the net export rather than the gross production of the PV system. When household loads requires electricity more than the amount of electricity the PV system is producing, the balance of electricity required by the loads is imported from the grid and recorded. Net exports typically vary from 10% to 50% of the total production of PV system. This percentage depends on the consumption level of the households and the size of PV system.

3. Feed-in tariff in Australia

Different states and territories in Australia are implementing different feed-in tariffs [2]. Table 1 shows the feed-in tariff currently being implemented in Australia's states and territories. The main purpose is to encouraging homeowners and small businesses to install solar PV systems and produce part of their consumption.

In most of the states and territories, the owners of grid-connect photovoltaic solar power systems are paid for any excess electricity production that is fed back into the grid. Only in NSW and ACT, the feed-in tariff is based on gross production of the PV system.

4. Feed-in tariff in Victoria

In order to encourage and support the community, the Victorian Government has introduced two different feed-in tariffs [3]. The feed-in tariffs available to the community are:

- Premium feed-in tariff for solar.
- Standard feed-in tariff for renewable energy.

In Victoria, the owners of grid-connect photovoltaic solar power systems are paid for any excess electricity production that is fed back into the grid (net FIT). Most of the electricity retailers in Victoria are offering between 60 and 68 Australian cents per kWh for unused electricity fed back into the grid. A 1 kW PV system installed in Victoria can produce in average about 4–5 kWh of electricity. What percentage of this amount is used by household and how much the owner is paid back by the electricity retailer depends on level of electricity consumption by the households and size of PV system. Under the premium feed-in tariff, households, as well as community organisations and small businesses that consume less than 100 MWh a year, can be rewarded with a credit of minimum 60 cents per kilowatt hour for excess electricity they feed back into the state electricity grid.

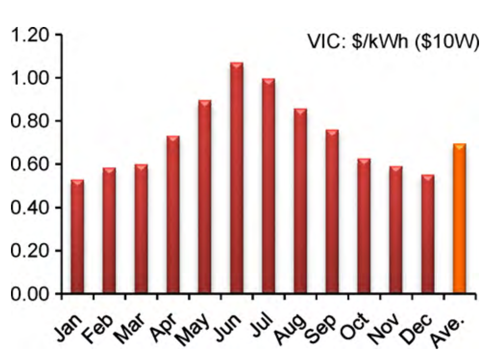


Fig. 1. Monthly average production cost, Melbourne [6].

The standard feed-in tariff applies to larger renewable power systems for homes and businesses (up to 100 kW in size) including solar, wind, hydro and biomass. Under the standard feed-in tariff, customers are paid the regular retail rate for excess power they do not use.

Fig. 1 shows the production cost of PV electricity in different month of the year and the average cost in Melbourne area for the case that the money to purchase the PV system is borrowed from a bank. Parameters used for this cost calculation are: inflation rate: 2.5%, discount rate 4%, money to purchase and install the PV system is assumed to be borrowed at mortgage rate of 4%, system and mortgage period: 20 years. The average installation cost per KW of a PV system is assumed to be $10,000 in calculation of production cost, which seems to be very optimistic. De-rating factor (performance ratio: 75%).

5. Feed-in tariff in NSW

Feed-in tariff in NSW, which is a gross production scheme, is based on the total solar energy produced by roof-top PV system rather than payments based only on what is unused by the households [4]. Under this scheme, homeowners will know how much they will be paid for all the energy their solar PV system produce.

The NSW scheme has a cap on the size of home solar PV systems of 10 kW. Creating certainty in the feed-in-tariff scheme is one way to encourage households to invest in solar technology and support the clean energy technology.

There have been significant increases in the number of PV systems installed in NSW, with near exponential growth since mid-2007.

Fig. 2 shows the production cost of PV electricity in different month and the average PV electricity cost in Sydney area.

6. South Australia's feed-in tariff

South Australia's feed-in tariff is a premium electricity tariff (cost per unit of electricity) available to South Australian electricity customers for electricity generated by a small-scale grid-connected solar photovoltaic (PV) system, which is in excess of the household's consumption. To receive the incentive, this electricity must be returned to the grid. The minimum guaranteed tariff is set at A$0.44 per unit of electricity [5]. Not all electricity retailers may choose to offer contracts to solar PV customers and those that do may choose to add to this incentive. The scheme commenced on 1 July 2008.

Normal charges apply to the quantity of electricity drawn from the grid by the customer. The feed-in tariff of $0.44 per unit of electricity is applied to the total quantity of electricity returned to

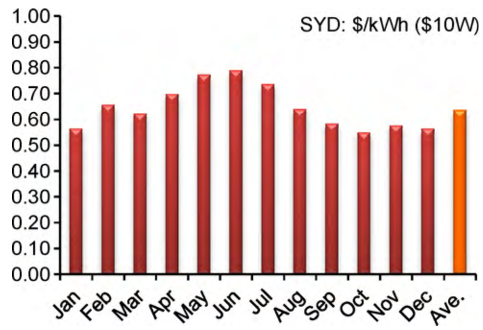


Fig. 2. Monthly average production cost, Sydney [6].

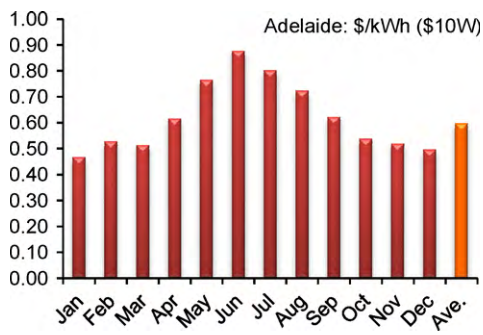


Fig. 3. Monthly average production cost, Adelaide [6].

the grid and reduces these 'normal charges' by the subsequent amount.

The average PV system installed in South Australia is 1.6 kW in size and would typically generate over 2000 kWh per annum (depending on exactly where in the state it is installed, its orientation and any obstructions to its solar access). In South Australia, on average, around half the electricity generated by solar electricity systems is returned to the grid.

Some electricity retailers will add a further amount to pay for the electricity they receive from customers, meaning customers could receive as much as 50 cents per kilowatt hour in total.

The amount a household returns to the grid will depend on how much energy is being consumed in the house when the solar panels are generating power. PV owners have the opportunity to maximise their income from their solar system by improving the energy efficiency of their house and returning more power to the grid. Fig. 3 shows the production cost of PV electricity in different month and the average PV electricity cost in Adelaide.

7. Feed-in tariff in ACT

From 1 March 2009 until 30 June 2010 the premium price will be 50.05 cents per kilowatt hour generated for systems up to 10 kW. For systems between 10 and 30 kW a rate of 40.04 cents per kilowatt hour will be paid [9].

The premium price is set each year. However, when system owners enter into an arrangement with their electricity supplier they are guaranteed payment of the premium price prevailing at that time for the full 20 years of their agreement.

The ACT Feed-in Tariff Scheme is based on gross generation, so system owner are paid for each unit of electricity that they generate.

Fig. 4 shows the production cost of PV electricity in different month and the average PV electricity cost in Canberra.

8. Queensland feed-in tariff

In Queensland the feed-in tariff is known as Solar Bonus Scheme. The Queensland Government Solar Bonus Scheme pays households and other small customers for the surplus electricity generated from roof-top solar photovoltaic (PV) panel systems that are exported to the Queensland electricity grid. The scheme is designed to make solar power more affordable for Queenslanders, stimulate the solar power industry and encourage energy efficiency.

The scheme rewards customers whenever they generate more electricity than they are using – not just the balance at the end of the quarter, but whenever generation exceeds consumption during the day.

The scheme is designed to boost the state's use of solar PV electricity energy, encourage energy efficiency and stimulate the solar power industry in Queensland.

The Solar Bonus Scheme commenced on 1 July 2008. Customers participating in the scheme will be paid 44 cents per kilowatt hour (kWh) for surplus electricity fed into the grid. The current general domestic use tariff of 18.84 c/kWh (including GST as at 1 July 2009) [7,8,10].

The amount of electricity a customer returns to the grid will depend on how much energy is being consumed while the solar panels are generating power. Customers may be able to maximise their solar bonus by improving the energy efficiency of their home to export more electricity to the grid. This could be achieved by reducing standby power consumption, shifting some tasks to the evening and minimising the use of air-conditioners.

To be eligible to receive the solar bonus, customers must consume less than 100 megawatt hours (MWh) of electricity a year. In Queensland the average household uses approximately 7.6 MWh a year and have solar PV systems with a capacity of up to 10 kV A for single phase power and 30 kV A for three-phase power.

Fig. 5 shows the production cost of PV electricity in different month and the average PV electricity cost in Brisbane.

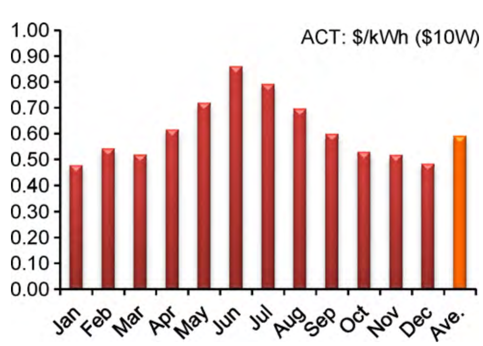


Fig. 4. Monthly average production cost, Canberra [6].

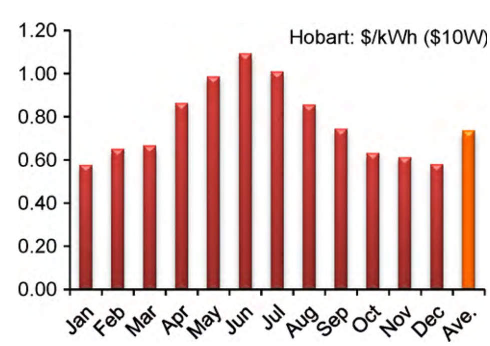


Fig. 5. Monthly average production cost, Hobart [6].

Table 2
radiations, annual production, average production cost and currently FIT being implemented in different states and territories in Australia.

	State	Annual average radiation (kWh/m^2/day)	Annual average PV electricity production (kWh)	PV production cost in $/kWh	Current FIT
1	Victoria	4.44	1153	0.69	Up to 66 cents
2	Western Australia	5.32	1381	0.58	60 cents (July 2010) [11]
3	South Australia	5.15	1339	0.60	44 cents
4	Northern Territory	6.26	1628	0.49	TBA
5	Queensland	5.08	1321	0.60	44 cents
6	Australia Capital Territory	5.20	1352	0.59	50.05 cents
7	New South Wales	4.85	1257	0.64	60 cents
8	Tasmania	4.18	1087	0.74	20 cents

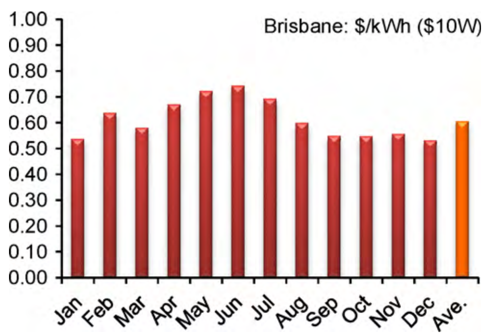


Fig. 6. Monthly average production cost, Brisbane.

9. Tasmania feed-in tariff

The Government of Tasmania will be mandating a net feed-in tariff for systems up to 3 kW paid at a rate equal to the normal purchase price of electricity to standard Aurora customers. Table 2 compares the production cost of PV electricity with the FIT currently implemented in different Australian states and territories.

Fig. 6 shows the production cost of PV electricity in different month and the average PV electricity cost in Hobart.

10. Conclusions and remarks

Most of grid-connected photovoltaic (PV) systems on residential or commercial buildings are installed by individuals interested in generating part of their electricity emission-free. For some of these people the economics of the PV electricity is likely to be of secondary importance, but majority of them would like to see return to become interested in using PV technology for electricity production.

The review results show that the gap between production cost of PV electricity and the feed-in tariff is relatively high, particularly in those states, were feed-in tariff based on net metering is implemented. A fair formula for gross FIT for every state would be: production cost minus electricity retail price of the state, otherwise FIT would not be attractive and encouraging.

Risk of feed-in tariffs based on net metering is that one could minimize the electricity consumption during the day and shift use of most of heavy loads and tasks to the evening, consequently putting extra pressure on the peak load periods.

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